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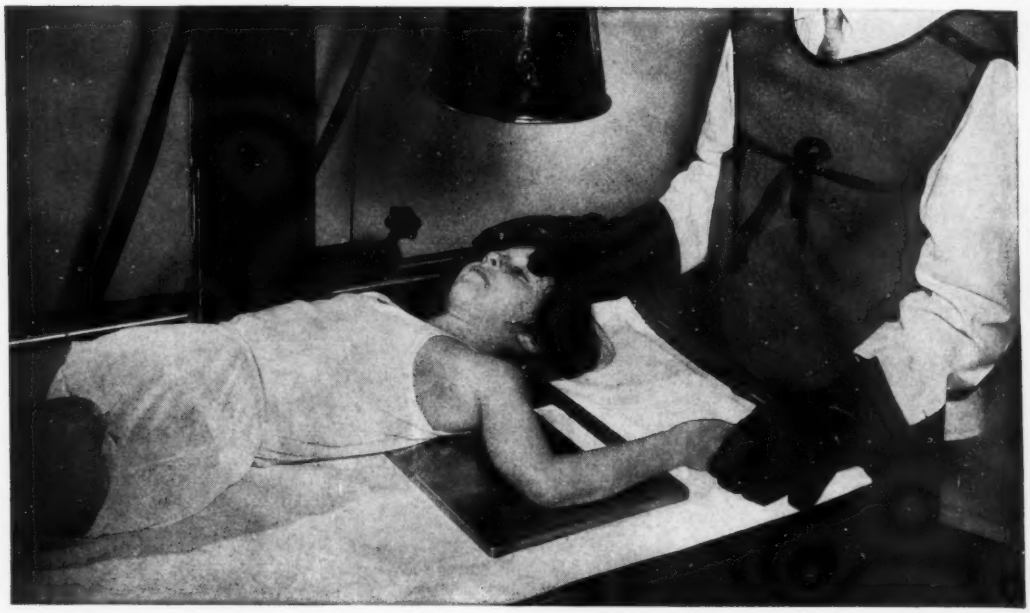

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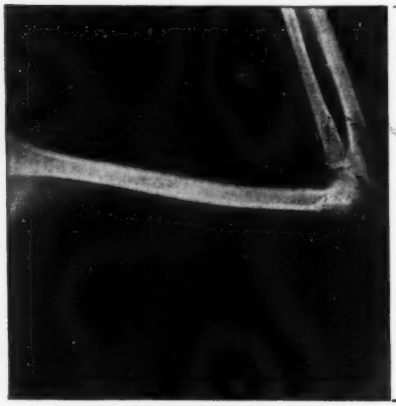

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# DOUBLE GALL BLADDER
## REPORT OF ONE ASYMPTOMATIC CASE DEMONSTRATED ROENTGENOLOGICALLY

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A double gall bladder is a rare congenital anomaly. Boyden[2] in 1926 found five cases in 19,000 human examinations. Galambos and Galambos[7] reported 9 cases collected over a period of 25 years. The number of published cases up to 1955 was estimated to be about fifty[17]. The statistics of Flannery and Caster[6], based on 101 cases of congenital gall bladder abnormalities included 25 true duplications.

Figure 1. Oral Cholecystography. Two distinct Gall Bladders partially superimposed on each other.

To these cases we wish to add our own which concerns a 54-year old white male. The patient had no symptoms suggesting gall bladder disease. However, a routine oral cholecystography disclosed two distinct gall bladders adjacent to each other. Both vesicles showed good concentration of the dye. One appeared slightly elongated and convoluted and the other was ovoid in shape. (Fig. 1) No calculi were found in either sac. Both responded well to cholecystokinetic fatty stimulus. (Fig. 2) The examination was repeated by means of intravenous injection of Cholografin (Fig. 3 A, B, C). This resulted in visualization of the biliary ducts as well as the two gall bladders. It was, however, impossible to determine whether the two gall bladders were united by their necks or whether each possessed its own short cystic duct. The radiological investigation of the gastro-intestinal tract disclosed only a solitary duodenal diverticulum.

The roentgenogram of the chest was negative.

Figure 2. Oral cholecystography 45 minutes after fat meal.

### Historical Review

Ancient Hebrew Talmudic laws mention double gall bladder in animals which rendered them unfit for consumption. In 31 B.C. Pliny reported a case of this condition in a victim sacrificed on the occasion of Augustus' victory at Actium. The first medical case was reported in 1677 by Blasius who found it on autopsy of a 2 year old boy[5]. Sherren[5] in 1911, was the first surgeon to operate on a case of double gall bladder. A double parallel row of radiopaque calculi enabled Nichols in 1926[12] to diagnose the anomaly roentgenologically, but the first cholecystographic demonstration of a double gall bladder was made by Ullmand[19] in the same year.

## Classification

An excellent study of the subject is found in Boyden's[2] paper. His classification may be summarized as follows:

1. Pancreatic bladders arising from pancreatic anlage and found only in animals.
2. Bladders of hepatic origin.
   1. Cleft gall bladders. In a 4-week embryo a diverticulum arises from the ventral aspect of the primitive gut. The cranial portion of this diverticulum differentiates into liver, and the caudal into gall bladder and ducts. The initial sub-division of the cystic diverticulum results in bi-lobed gall bladders in which two compartments empty in the common neck. There is only one cystic duct.

Figure 3A. Intravenous cholecystography 60 minutes after injection.

   2. Diverticular gall bladders. These arise from cellular buds on the neck of the embryonic gall bladders. This variety also possesses one cystic duct.
   3. Ductular gall bladders. Small cellular outpocketings are frequently found on embryonic cystic, hepatic, or common bile ducts. These buds normally disappear during fetal life. The failure of regression results in double gall bladder. In those, considered by some authors[3] to be true double gall bladders, there are two cystic ducts which either drain separately or join each other in a Y shape to form a common cystic duct.

Figure 3B. Intravenous Cholecystography. Two distinct Gall Bladders partially superimposed on each other. The hepatic and common bile ducts are well visualized.

Figure 3C. Intravenous Cholecystography. Two distinct Gall Bladders partially superimposed on each other. The hepatic and common bile ducts are well visualized.

4. Trabecular bladders. Vesicular outgrowths of hepatic trabeculae are found only in the animal kingdom.

### Clinical and Radiological Considerations

According to Hicken et al[8], ninety-five percent of double gall bladders are functionally normal. The two vesicles may occupy the same anatomical position or be distant from each other. In the first case they usually appear more or less superimposed on each other but oblique views and graded compression will dissociate the two shadows. If distant, one gall bladder may be found below the left hepatic lobe, in the gastro-hepatic ligament, or buried in the hepatic parenchyma. There are sometimes other associated developmental anomalies[7,11].

The anomaly of double gall bladder does not, per se, cause symptoms. However, both organs are subject to the same disease processes as a single organ. Cases of cholecystitis and cholelithiasis[1,3,5,9,10,12,18], suppurative cholangitis[8], torsion[15] and cholesterolosis[13] affecting one or both vesicles have been reported. Puzzling diagnostic problems may be encountered. Moore and Hurley[10] reported a case of a 30-year old female presenting clinical symptomatology suggestive of cholecystitis. The cholecystography disclosed a shadow of apparently normal gall bladder, a finding which seemed to contradict the clinical diagnosis. Nevertheless, the patient was explored by laparotomy, and a double gall bladder was found. One viscus was normal; the second, involved by cholecystitis, was responsible for the acute symptomatology.

### Summary

1. One asymptomatic case of roentgenologically demonstrated double gall bladder is presented.

2. Classification of the anomaly is given.

3. The clinical and radiological aspects are discussed and occasional diagnostic difficulties are stressed.

*ACKNOWLEDGMENT: The author wishes to thank Dr. K. Mooney for permission to report this case.*

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# THE PRE-NATAL DIAGNOSIS OF THORACOPAGUS TWINS*

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Of the many foetal abnormalities a radiologist has to consider in assessing a foetus-in-utero, Siamese twins are probably the least likely to come to his mind. Chapters on foetal monstrosities in standard texts are as a rule given only scant attention, partly explained by the rarity of such monsters, as well as by the assumption that these should be easily recognisable when seen on a satisfactory radiograph of the maternal abdomen. And indeed such is usually the case, if one considers anencephalic monsters, one of the commoner examples. Thoracopagus twins have not been previously reported as diagnosed before birth. The case to be described caused considerable diagnostic difficulties, and is therefore considered worthy of record.

## Case Report

Mrs. Z., aged 34, mother of two healthy daughters, underwent a normal third pregnancy up to the 7th month, when an unsuccessful attempt to turn a breech presentation led to her referral for X-ray examination. A single antero-posterior view of the abdomen with compression was obtained. As soon as the film was viewed a strong suspicion of Siamese twins was entertained, and verbally expressed by an orthopedic colleague present in the department at the time. Figure 1 shows the twin pregnancy, with both foeti presenting by the breech, lying parallel to each other in approximately the midabdomen with both spines extended, and with a tendency to face each other. Both were lying at the same level, with the legs lying inferior to the bodies. All of these features strongly suggested the diagnosis, and it was thought that it would be a relatively easy matter to prove it, since joined twins would presumably maintain the same attitude to each other, irrespective of the position of the maternal abdomen on the X-ray table.

Figure 1. Preliminary AP view. Extended spines, obliquely facing heads, with lower limbs in maternal pelvis.

*Received for publication November 1957.

Figure 2. Lateral view. Note the spines remain extended, but that they are crossing each other superiorly. Bellies are pushed apart.

Thus, the following day, lateral and oblique views were obtained, (Figs. 2 and 3), to prove the presumptive diagnosis. As a result of these the diagnosis was doubted. The twins remained in the breech position, and again tended to face each other, but the cervico-dorsal spines crossed each other in both views, and the foetal bellies tended to be separated. Although in both additional views the spine of one baby had a more normal curve, i.e. flexed attitude, the spine of the other remained extended. Close inspection of the films failed to reveal any obvious foetal abnormality in either twin. Thus although it was clear that one was dealing with some foetal abnormality, joined twins appeared to become a rather remote possibility by virtue of the apparent movement of the twins relative to each other. The films suggested that the placenta was lying in the fundus superiorly. A repeat film of the abdomen nearer term was recommended.

This additional film was obtained 3 weeks later (Fig. 4). Again the twins presented by the breech facing each other, the left one at a slightly lower level than the right, with both spines extended. Discussion with the attending obstetrician revealed that there was no evidence of oligoamnios to account for the foetal attitude. One foetal heart only could be heard. Since it was clinically not possible to move the twins relative to each other, it was finally considered that a diagnosis of Siamese twins, though not proven, could not be ruled out. It was pointed out that a bony junction between the twins could be excluded, but that a xiphipagus or omphalopagus type of junction was a distinct possibility, if the twins were

joined, to allow for their relative mobility on each other on the X-ray evidence. It was thought that any junction would probably be relatively small, a point which proved to be quite incorrect.

Caesarean section was performed on the 12.7.1957, after a further straight film of the abdomen in hospital had revealed no change in the foetal attitude. Live conjoined girl twins of the thoracopagus type were delivered.

Figure 3. Oblique view. The same features as in figure (2) are seen. No evidence of intrinsic bony abnormality in either foetus.

Figure 4. AP view. 3 weeks later. The general alignment of the foeti is essentially similar to that in figure (1).

Figure 5 was obtained at the Regina General Hospital, and is shown by courtesy of Dr. A. J. Richards. It showed the soft tissue junction between the twins from the level of the lower sternum down to the umbilicus. The foetal spines remained extended, and the hearts were tipped forwards towards each other, suggesting a probable communication. This in fact was borne out by a synchronous heart beat, confirmed electrocardiographically. Below the hearts a band of homogeneous density was noted, raising the probability of a partially common liver. Separate stomach gas bubbles were visible, but gas was seen above and at the level of the umbilicus, suggesting a junction of the small intestines. Separate colons were demonstrated radiographically. All these features were confirmed at autopsy, the infants dying 3 days following birth.

Figure 5. Post-partum view. Note the extensive soft tissue bridges between the twins, the forward tipped hearts, the separate stomach gas bubbles and the junction of the small intestines.

## Discussion

The incidence of conjoined twins is uncertain, the usual figures quoted being those of Potter[8], one in 60,000 at the Chicago Lying-In Hospital, and one in 35,000 at the Mount Sinai Hospital[9]. In Regina, with a population of at present about 90,000, the reported case is the first as far as known. Aird[1] states "My belief is that we may expect each year, over the world as a whole, the birth of half a dozen or more conjoined twins capable of separation". Elsewhere he mentions "I have recently been informed of several cases in which an umbilical junction of minor extent has been successfully separated just after birth and the event not thought worthy of medical record". Apart

from reported conjoined twins who lived, there must surely in addition be a further number of unreported cases dying at or soon after birth. Thus the overall incidence is in fact unknown, but probably higher than generally thought.

Conjoined twins may be symmetrical or asymmetrical, and their usual classification and nomenclature depends on the point of junction of the two bodies. Double monsters have always aroused the greatest curiosity from time immemorial, and the interested reader is referred to Gould and Pyle's "Anomalies and Curiosities of Medicine[5]", published 1896, reprinted 1956, for a full description of some of the best known historical examples.

So far radiology has played a relatively unimportant part in the diagnosis of conjoined twins, most studies being undertaken after delivery, to assess the linkage and possible surgical separation. The investigation of the Kano twins[1] is an excellent example of the part radiology has to play in this regard.

A pre-natal diagnosis is clearly desirable in order to warn the obstetrician, and to guide him in his choice of the method of delivery of the mother. Few ante-partum examples of conjoined twins have been described. Brailsford[4] demonstrated a double monster (dicephalus quadribrachius) in his textbook, and a similar monster (dicephalus dibrachius) is shown in Modern Trends in Diagnostic Radiology[7]. A post-partum film of a craniopagus which was diagnosed before birth, is shown in the paper by Wilson and alia[10].

As above stated, a thoracopagus has not yet been reported as diagnosed before birth. Thus it is thought worth-while to review previously undiagnosed cases, and to evaluate diagnostic criteria of the omphalopagus, xiphipagus and thoracopagus type of twins, which represent the commonest types of double monsters. In these the junction is only a soft tissue one at the umbilicus, or in the case of the xiphipagus by soft tissue with or without a communicating cartilaginous band at the lower end of the sternum, or a more extensive linkage from the lower sternum down to the umbilicus. In the latter case, the thoracopagus, a communication between the hearts, the livers and the upper small intestines can be expected.

The first and most instructive case was reported by Graber[6] in 1945, a double breech twin pregnancy being confirmed radiologically at 36 weeks. In his comment the author stated that the radiological diagnosis should have been made before labour, the heads of the twins lying at the same level on the right side of the maternal abdomen, one extended, and in direct apposition to each other. Review of the satisfactory film showed both foeti lying close together, with the spine of one extended, that of the other virtually extended. The thoracic cages were facing each other, and the heads close together, oblique to each other.

Becker[3] reported the next case in 1950, but unfortunately the reproduction cannot be evaluated. In this case also the diagnosis was not made until during labour. This was a bicephalic presentation, again with both heads close together. Becker felt that the X-ray diagnosis would probably not be made in most instances, and it is interesting that Baird[2] states "In the case of thoracopagus, if the union between the two is slight the radiograph may present the picture of a simple plural pregnancy".

A further case was reported by Reitman and alia[9], a radiological diagnosis of a twin pregnancy being made, both breeches presenting. The film was not reproduced in their paper. The diagnosis was again made during labour, by which time one twin had turned to a cephalic presentation. This latter point must be particularly stressed. The xiphoid junction measured 1 by 4 cms. in these twins, and allowed them to rotate about each other. This evidently also occurred in the original "Siamese" twins in spite of a cartilaginous band from sternum to sternum[5]. Reporting on the Kano twins, Aird[1] mentioned that there was a bridge of cartilage from one chest to the other, which "cut easily, but was so rigid that it was surprising to recollect that the babies had been twisted through 90 degrees at birth". One of the Kano twins was born as a vertex, the other by the breech. It is thus evident that in spite of a cartilaginous junction, let alone a soft tissue one only, rotation of one twin on the other is possible and that thoracopagi may present both by the head, both by the breech, or rotated upon each other to various extent on a radiograph. This was not appreciated in the presented case, and caused the diagnostic difficulties above described.

The only other similar case known to the writer, where pre-natal radiographs are available is that of the Alberta twins born in 1949. Through the kindness of Dr. W. H. Freebury of Tofield, Alberta, the radiographs were made available to the writer. One of the films showed essentially the same features as the reported case, namely a double breech presentation with extension of the spines, both foeti lying parallel to each other on either side of the mother's lumbar spine, with the heads facing each other. The exact position of the limbs could not be fully evaluated. It was noted that there was evidently ample room in the uterus on either side of the then about 7 months old twins. Prior to birth the foeti rotated, and both were delivered by the vertex, the maternal pelvis being roomy.

### Summary of radiological features

Although final conclusions cannot be reached from such a limited number of cases, the available evidence indicates the following radiological signs for the diagnosis of thoracopagus twins in utero.

1. The most valuable, and evidently diagnostic feature is clearly the alignment of the foetal spines. In normal twins a flexed attitude of the foetal spines will usually be seen. In joined twins the foetal spines must always be abnormal, i.e. either fully extended, or at least partially extended, since the joined bodies which face each other will prevent the assumption of a normal flexed attitude. Relative mobility of the foetal bodies to each other is no bar to the diagnosis, since varying degrees of rotation are possible as judged from the analysed cases. Although follow-up films may show a change in the position of the twins within the uterus, the alignment of the foetal spines will remain abnormal.

2. If the twins present head to head, breech to breech, the heads will lie at the same level, and remain at approximately the same level on follow-up radiographs, either facing each other, or obliquely set to each other, close together.

3. The limbs will not be in their usual flexed position, but spreadeagled in various directions in the uterus.

4. No bony junction will be apparent.

Considerable caution must be exercised in diagnosing too much. Not all otherwise normal twins have a normal attitude in the uterus. If joined twins are thought of, the above criteria should suggest the correct diagnosis. In any case of doubt, as was done in the presented one, follow-up radiographs will give a strong lead to make or refute the diagnosis.

## Conclusion

A case of thoracopagus twins is presented in which the diagnosis was tentatively suggested on radiographs obtained before birth. Similar known, undiagnosed cases have been reviewed. The radiological signs as judged from the few available cases are described. It is pointed out that relative mobility of the foeti on each other is possible, and no bar to the diagnosis.

*ACKNOWLEDGMENTS: My thanks are due to Dr. F. H. Munkley and Dr. A. J. Richards of Regina, Dr. E. S. Allin of Edmonton, and particularly Dr. W. H. Freebury of Tofield, Alberta, for their help and co-operation.*

## Addendum

Since this paper was submitted for publication two further cases have come to the author's attention, in which the pre-natal diagnosis of conjoined twins of the thoracopagus (a) and omphalopagus (b) type respectively was suggested. Although the radiographs of neither case were reproduced, the described radiological features were similar to those presented in this paper, lending strong support for the validity of the suggested diagnostic criteria.

a) Stiggelbout, W., A case of Conjoined Twins, Brit. Med. Journal, 1958, 727-728.

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# MALIGNANT TUMOURS OF THE SMALL BOWEL

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Malignant tumours of the small intestine are rare. However, within a three-month period, three patients with jejunal tumour were seen at the X-ray department of the Hôtel-Dieu de Québec. The low incidence of malignant tumours of the small intestine is well known. Ewing states that such neoplasms account for 3% of digestive tract tumours. From 1905 to 1935, 29 malignant tumours of the small intestine were found in the course of 22,810 autopsies performed at Bellevue Hospital in New York. Jenkinson and his co-workers[13] reported a ratio of 36 cases of tumour of the colon to 1 of the small intestine. According to Railsford, malignant tumours of the small intestine would amount to 4.9% of malignant tumours of the digestive tract. The figure given by Brill is 2.5%. Richardson and Flatt[21] of London Hospital, have reported 13 cases of malignant tumour of the small intestine located below the duodeno-jejunal flexure over the period 1908-1952. At University Hospital in Cleveland, one malignant tumour of the small intestine was found in 9,000 admissions. In a period of forty years, Weinberger[25] collected 20 primary tumours of the small instestine, i.e., 1 out of 71 neoplasms.

The absence of angulations such as those present in the colon, the fluid nature of the jejuno-ileal contents and their alkalinity, the non-stagnation of the contents of the small intestine, as well as the fact that its epithelium is not subject to sudden changes, would be factors that do not promote the growth of malignant lesions and would explain their rarity. Feldman[9] has even advanced a theory about an anticarcinogenic hormone that might be discharged by the small intestinal mucosa; the suppression of the hormone would promote the onset of a cancer.

In spite of the rare occurrence of small intestine tumours, their diagnosis should not be considered a matter for surgeons and pathologists only. The radiologist should think of it, while suggesting and, if need be, carrying out jejuno-ileal transit after the now well-recognized procedures, i.e. barium meal, simple enema or double-contrast enema of the small intestine.

In this department, we have used barium meal only, up to now. Once the patient has been fed a glass of barium, his stomach and duodenum are examined. If the examination is negative, the patient is given a second glass of barium and seen again for fluoroscopy after ½, 1½, 3 and 6 hours. This was the method used in arriving at a diagnosis in the three cases we will now describe.

Mr. O. C., a forty-one year old male, was admitted to the Hôtel-Dieu de Québec on March 27th, 1957, for abdominal pains and obstruction. The patient had been complaining of pain in his umbilical region since November 1956. He had been operated on for appendicitis in February 1957, in a regional hospital. He failed to improve after the operation. The pains grew worse, occurring chiefly at night. The man suffered from severe constipation, without nausea, vomiting or melena. His appetite decreased slightly and he lost weight. There was nothing noteworthy in the past history, except typhoid fever at the age of six. On physical examination the abdomen was swollen slightly, hard on palpation, but without real rigidity. A mass was felt in the umbilical region under the painful spot. There was no inguinal adenopathy.

On radiological examination, the films taken after ½ and 1½ hours showed a greatly dilated jejunal coil, rigid, jagged, and painful under pressure. This coil was isolated and it corresponded to the palpable mass. (Fig. 1.)

Figure 1. Lymphosarcoma of the jejunum.

A jejunal mass was found at operation, with numerous nodes present. Side to side anastomosis was performed and a node excised for examination. The report from the department of pathology gave a diagnosis of lymphoblastic reticuloma.

The patient was given teleroentgentherapy. He was slightly improved upon discharge on April 6th, but was readmitted on April 28th with 167 mgm. per 100 c.c. azotemia, hemoglobin 9.9 gms. and R.B.C. 3,700,000. On May 4th, azotemia read 219 mgm. per 100 c.c., and on May 11th, 335 mgm. per 100 c.c. The patient died on May 16th with anuria. Permission for autopsy was not granted.

Classical radiological signs of lymphosarcoma of the small intestine were present in this patient: dilatation, rigidity and isolation of a jejunal coil with jagged walls and corresponding mass. The radiological signs supporting the clinical symptoms of pain, loss of weight and anorexia,

led us to the diagnosis of lymphosarcoma. Adenocarcinomata are small, constrictive, stenosing tumours. The clinical picture is different in ileitis and tuberculosis of the small intestine, the chief symptom in both these diseases being diarrhea. In ileitis, the stenosis is located chiefly in the terminal ileum, while tuberculous ileitis invades the ileum and the caecum and occurs in known cases of pulmonary tuberculosis.

Mr. H. M. was a fifty-five year old male admitted on April 14th, 1957. This patient had lost 25 pounds since January 1957. Suffering from anorexia, he had had abdominal pains for three weeks. Restricted to the left side at first, the pains had become generalized. The patient had been constipated for three weeks, with few and laborious stools. His mother died with intestinal neoplasm at the age of sixty-five. A heavy smoker, the patient drank alcohol moderately. An X-ray taken previously in another hospital showed a decreased transit rate at the level of a small intestinal coil.

On physical examination the patient's abdomen was distended: there was objective as well as subjective tenderness, with a palpable mass in the left hypochondrium.

A small intestine study showed a 4½ cm. narrowing at the first jejunal coil level, with obliteration of the mucosa, rigidity and deformation of the walls. This lesion corresponded to the palpable mass. (Figs. 2A and 2B).

Figure 2A. Area of stenosis in the upper jejunum.

The patient underwent a laparotomy. A tumour infiltrating the mesentery, spotted with a great number of nodes, was found. The tumour reached into the pre-aortic retroperitoneal region. Everything appeared to form one mass with the pre-vertebral large vessels. A node was excised and a jejuno-jejunal anastomosis performed.

The pathologist reported that the specimen was a nodular metastasis of an adenocarcinoma of the digestive type, possibly from pancreas or colon. Radiological examination of the colon was negative. The patient went home slightly improved.

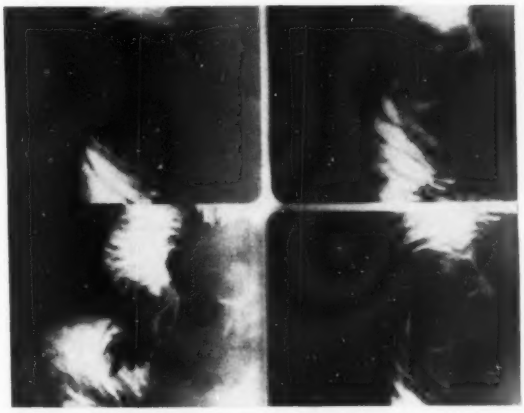

Figure 2B. Spot film of the region invaded.

There was no doubt that the condition was that of a malignant digestive lesion. The narrowed small intestine coil seen on radiograms was not excised, and the pathologist advanced the hypothesis of a neoplasm of the pancreas or colon, but a jejuno-ileal origin was not excluded. Radiologically the lesion looked like an adenocarcinoma of the small intestine. However, it would not be impossible for the small intestine to be secondarily infiltrated or even for it to be compressed or strangulated by the mesenteric mass. Golden[12] asserts that mesenteric tumours may give the same picture as a jejuno-ileal tumour.

Mr. D. F., a forty year old male, was admitted on June 7th, 1957. This patient suffered from a "douleur en barre" in his epigastrium for two months, and for the last three or four weeks, he had experienced vomiting of bile and heaviness after meals. The heaviness was not relieved by either food or alkalies. He had lost 25 pounds since the onset of his illness. An induration was felt in the sub-umbilical region on physical examination. Blood count and azotemia were normal.

Figure 3A. Dilatation of the 1st jejunal loop. Stenosis in the upper left region.

Radiological examination of the stomach showed no organic lesion. However, the duodenum and the first jejunal coil were moderately dilated above a 5 cm. narrowing. This segment was rigid, with obliterated mucosal folds. It did not adhere to the adjacent organs. (Figs. 3A and 3B.)

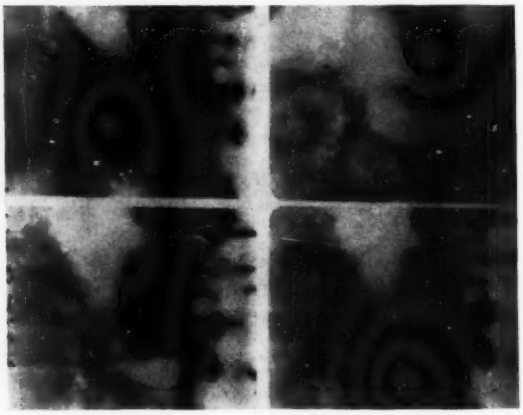

Figure 3B. Lymphosarcoma. Spot film of the narrowed region.

Once the abdomen was opened, the regional ileitis of three adjacent segments of the upper jejunum was noted, with marked adenitis of the mesentery. Thirty inches of the upper portion of the jejunum and the corresponding mesocolon were excised.

The pathologist noted a narrowed, whitish and reddish area circling the small intestine and extending over 7 cms. The area was surrounded by thickened mesocolon containing several nodular formations. Histologically, it was a reticulosarcoma of the jejunum with infiltration of the nodes.

The patient was given X-ray therapy: 6900 r on three fields. He was feeling well when seen again in August.

This patient's symptoms were referred to the upper digestive tract, which tallies with a high jejunal lesion. The narrowing noted is suggestive of a carcinomatous lesion, although a degree of early dilatation with stiffening of the walls might suggest a lymphosarcoma. The surgeon believed he was dealing with regional ileitis. The anatomopathologist stated the lesion was of a sarcomatous nature. This shows it is often impossible to arrive at an accurate histological diagnosis, when visualizing a lesion in the X-ray department. However, we found it possible to assert there existed a malignant lesion. This was a case of reticulosarcoma, possibly in the early stage, and the prognosis appears to be better in this last case than in the other two.

The clinical symptoms presented by these three patients and the radiological signs, tally with the clinical symptoms and the radiological signs found in malignant tumours of the small intestine. The histological report did not agree in all cases with the pre-laparotomy opinion, but the malignancy of the lesions was evident in the three patients.

Malignant tumours of the small intestine fall into three large groups: (1) carcinomas including adenocarcinomas; (2) lymphosarcomas: follicular, Hodgkin type and reticulosarcomas; (3) carcinoids.

The general clinical symptoms are those common to all cancers, that is, anorexia, loss of weight, anemia. Para-umbilical pain is a rather constant symptom. It is a vague pain without precise features, which does not appear "on schedule". Lesions of the upper jejunum give rise to gastroduodenal symptoms, such as nausea, vomiting, post-prandial heaviness. Faeces are often positive for blood. Lesions of the lower jejunum are evidenced mainly by obstruction and abdominal pains. One should think of a tumour of the small intestine if the patient passes red blood in his stools and if the colon examination is perfectly negative.

Malignant tumours of the small intestine often show themselves by intestinal obstruction; this occurs in adenocarcinomas 9 out of 10 times.

Intestinal invagination will sometimes be the tell-tale sign of a malignant tumour. According to Dundon[8], 4% of malignant tumours will invaginate. Invagination is chiefly characteristic of benign pedunculated tumours, however.

Amongst lymphosarcomas, the intestinal variety manifested by pain, diarrhea and obstruction may be mistaken for regional ileitis.

A long history of repeated attacks of obstruction with epigastric pain, nausea, vomiting and loss of weight is frequently the clinical picture in carcinoids.

The presence of a palpable mass would point more to a sarcomatous lesion.

For confirmation of the existence of a malignant lesion of the small intestine, radiology is called upon.

Once gastroduodenal and colic lesions have been ruled out through fluoroscopic and radiographic examinations of the stomach and colon, one must show patience and explore the small intestine radiologically.

This examination consists in feeding the patient 1 or 2 glasses of barium (one-half barium sulfate and one-half water) and then in fluoroscoping and radiographing him, preferably every half-hour until the barium leaves the ileum.

To accelerate the transit, cold isotonic physiologic saline solutions are used. Giraud[11], of Lyon, and his co-workers use 50 gm. of barium sulphate and 50 c.c. of physiologic saline. One hour later, if the stomach has emptied sufficiently, they have the patient take 250 c.c. of iced physiologic saline. Following the ingestion, 3 films are taken at ten-minute intervals.

We believe the first mentioned procedure to be preferable, although it requires more patience and takes more time.

When intestinal obstruction is present, the size of the narrowing and its neoplastic characteristics can be ascertained through the introduction of a catheter as far as the obstacle, and the injection of barium at that level. In many cases, this is the only means of arriving at a diagnosis.

What are the radiological signs of malignant tumours of the small intestine? They vary with the different groups.

In adenocarcinomas there is annular constriction with mucosal destruction and ulceration at times with a fungoid mass. A single, short segment is concerned. Feldman[9] has reported six cases of multiple primary carcinoma of the small intestine he collected in the literature, adding one personal case.

In lymphosarcomas, a narrowing simulating the stenosis of ileitis or the narrowing of adenocarcinoma can be seen. (This is the picture encountered in the third patient.) More often there is a sausage-like dilatation of a small intestine coil between two narrowed segments. The walls are rigid with jagged edges. The mucosa is destroyed and obliterated, with digital prints and pebbled surface. The diseased coil is isolated from the other coils, and there is a palpable corresponding mass (this is the radiological picture of the first patient). The intestinal infiltration is often multiple in lymphosarcomas as they reach out in various directions through the lymphatic channels.

Carcinoids are apt to remain quiet for a long time if located on the appendix. Later, they may produce signs of compression at the caecum level, compression signs like those encountered in mucoceles or appendicular abscesses. If the carcinoid is located at the terminal ileum, the signs of narrowing will be similar to those of adenocarcinomas.

A differential diagnosis must be attempted:

1. From metastatic narrowings —
   One will often have the notion that a cancer exists in an adjacent region. Uterine cancers are said to result in metastatic infiltrations of the small intestine.
2. From benign tumours —
   There is no general sign of cancer. An obstruction or an intussusception is often the first manifestation of a benign tumour. The mucosa is compressed but not destroyed in such a tumour.
3. From an extrinsic compression, as by a mesenteric tumour (which appeared to be the case of the second patient).
4. From regional ileitis —
   In this case, diarrhea is the chief symptom. The disease progresses slowly. The age of the patient and the general symptoms are different from those of malignant tumours.
5. From tuberculosis —
   Primary tuberculosis of the small intestine is rare and is chiefly located at the terminal ileum with involvement of the ileo-caecal valve and of the caecum.

Since the three patients exhibited the radiological signs of jejuno-ileal tumours, the most frequent tumours of the small intestine, namely, duodenal tumours, are left out of this paper. Also omitted are other malignant tumours that can be located in the small intestine, such as melanosarcomas, leiomyosarcomas, peritheliomas, myxosarcomas and fibrosarcomas.

In conclusion it may be stated that, with the elaborate equipment at our disposal and with the appropriate techniques handed down to us by masters such as Golden and others, radiologists must detect cancers wherever they are located. The small intestine must no longer be a dark maze to be explored by surgeons and pathologists only. It rests with the radiologist to shed light on this part of the anatomy and to guide the way for our friends of surgery and pathology.

Provided we think as clinicians and make an effort to carry out a rational examination of the small intestine more often, we shall have opportunities to detect malignant tumours in their early stage, and we shall save or lengthen the life of unfortunate people who are setting their hopes on our science and our knowledge.

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## ERRATA

Page 71, Volume IX (December), the third paragraph should have read:

> The Committee has made specific recommendations for some of the more commonly used isotopes such as $I^{131}$, $P^{32}$ and $Au^{198}$. For example, the routine diagnostic dose of $I^{131}$ should not exceed 25 microcuries, and with scintillation techniques it can often be much less. The use of $P^{32}$ in the treatment of diseases of the blood should be under the supervision of a physician trained in internal medicine, haematology or therapeutic radiology.

Volume X, which appears on each page of text, should have read: Volume IX.

# X-RAY EXAMINATION OF THE BREAST

by

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Roentgenography of the breast is not yet a generally accepted clinical procedure. This is not hard to understand if one considers the complexities of x-ray technique, the unfamiliarity of radiologists with the normal and abnormal appearance of the breast and the difficulties to be overcome in coordinating x-ray findings with the different conceptions of pathologists. With coordinated determination of surgeons and radiologists, these difficulties can be overcome and much additional valuable diagnostic information made available in the diagnosis and management of breast diseases.

## Technique

It is our routine practice to make lateral and cephalo-caudad views of each breast (Figs. 1a, 1b). A semi-elliptical cone is used for collimating the beam, (Fig. 2), the flat side of the cone being pressed against the patient's chest. Non-screen X-ray films are used. A fine focus tube is employed, the target being 0.3 mm. in diameter. The target film distance is 14 inches and the factors usually employed are 30-32 KV, 100 m.a. with exposures varying from 0.5 to 4.0 seconds. A small lead shot is usually affixed with transparent tape to the breast over the dominant lump or any other portion of the breast where signs are localized. These films are purposely over-exposed and must be examined with a bright light.

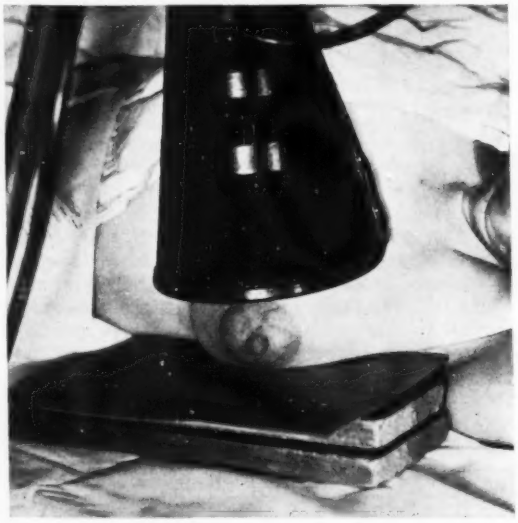

Figure 1a. The lateral view of the breast is obtained with the patient in the lateral decubitus position, lying on the side to be examined. The breast is extended upon the cassette or disposable film packet.

Figure 1b. The antero-posterior (cephalo-caudad) view of the breast is obtained with the patient seated. The breast is supported by the cassette or film holder which is held by the patient as shown.

## The Breast on the X-Ray Film

In addition to the enormous variation in the size and shape of the breast, there are wide variations in texture due principally to the varying amounts of fat. The accuracy of the X-ray examination depends chiefly on the contrast afforded by the fat in the breast so that the fatter the breast, the more easily it is studied on the X-ray film. The young virgin breast is usually characterized by dense homogeneous parenchymatous tissue. In the young adult woman fat begins to accumulate in the breast and usually more in the lower than in the upper half. In the adult breast the parenchymatous structures tend to become more localized in the upper outer quadrant of the breast and the distribution of the fat can become quite irregular. In women during and after the menopause, the atrophy of the breast and

the more or less uniform fatty composition of the organ permit very easy visualization of all the breast structures.

Among the benign diseases of the breast, those presenting themselves with multinodular changes present the most difficult problems. This is especially true when no dominant mass is palpable. But this type of breast presents the same problem to the surgeon. X-rays have the advantage of demonstrating changes which are not palpable. X-ray studies may therefore demonstrate a malignant process in the absence of a palpable lump.

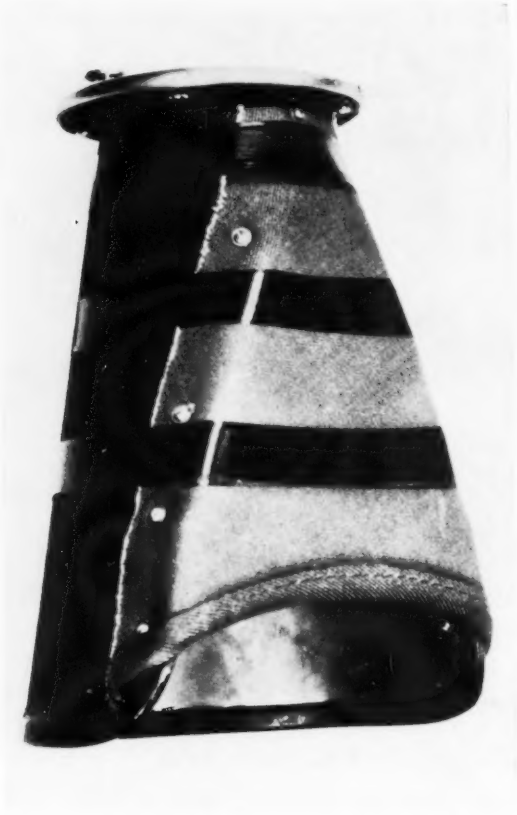

Figure 2. Roentgenographic cone designed for breast examination. Note the flattened surface for closer approximation of the cone to the chest wall.

An occasional case will present itself in which the patient has palpable lymph nodes in the axilla, which on biopsy turn out to be malignant. The clinician has failed to find a mass in the breast, and in such instances, the X-ray examination can be employed to search for the primary process.

By repeated studies of benign breasts, the radiologist soon becomes acquainted with the normal physiologic changes which occur in the breast during the reproductive phase and he soon learns to distinguish such conditions as chronic secretory disease, plasma cell mastitis, inflammatory cysts, abscesses and the various involutional changes of the breast.

After trying various classifications for malignant processes of the breast, we finally have evolved a simple one which answers our purposes quite well. We divide the roentgen features of breast cancer into (1) scirrhous, (2) circumscribed or medullary and (3) intraductal.

Each of these classifications has characteristic X-ray findings which help to facilitate the diagnosis.

Figure 3. Scirrhous Carcinoma. Irregular spiculated or tentacled density is well shown. The abnormal roentgen shadow was smaller in diameter than the clinically palpable mass.

The scirrhous type of cancer, (Fig. 3), on the X-ray film reveals the presence of irregular spiculated margins with some slightly increased density, distortion of the perifocal surrounding breast tissues and a mass which always measures less on the roentgenogram than it does clinically.

In the circumscribed or medullary type of cancer, (Fig. 4), the growth is usually characterized by well-circumscribed smooth margins not unlike those seen in cysts or fibroadenomata. However, on close inspection there will always be found some portion of the margin which is irregular due to extending infiltration into the surrounding parenchyma. It is this distortion of the perifocal tissues which differentiates these lesions from benign processes.

Figure 4. Circumscribed or Medullary Carcinoma. There is an abnormal rounded density with sharp but slightly irregular margins. Note linear extension or "tail" of increased density extending into adjacent breast tissues. The "tail" is not invariably present and differentiation from a cyst or fibroadenoma may be difficult or impossible on the roentgenograms.

Figure 5. Duct Carcinoma. A clumped group of fine punctate calcifications is seen within the breast in a subareolar location. The calcifications tend to follow the course of the ducts extending deeper into the breast. A mass was palpable beneath the areola. Pathologic report: Intraductal carcinoma.

Intraductal carcinomas, (Fig. 5), are characterized by the presence of irregularly distributed punctate crystalline calcific deposits which are characteristic and usually pathognomonic.

Whenever changes suggesting cancer are found in the presence of adenosis or fibrocystic disease, and the radiologist cannot be sure of his interpretation, he can suggest diagnostic resection without delay. This often entails surgical interference in the absence of a dominant mass, but may result in the removal of a cancer in its earliest stages.

## Discussion

During the past seven years the ratio of malignant to benign lesions found in the breast has been reduced from 1:10 to 1:2 in our series.

Before roentgenography of the breast can be put on a clinical basis, the radiologist must not only pay strict attention to technical details, but he must familiarize himself with the appearance of the normal breast as well as that of the diseased breast. This takes time and experience, but the same comments might be made in connection with any other X-ray skill. For instance, in the case of malignancy of the lungs, the average radiologist had to spend two or three years becoming acquainted with the appearance of the normal and diseased lung before he became sufficiently skilled to make reliable diagnoses of malignant processes. The same effort must be made in connection with the breast.

The question has been asked, "Why should we burden ourselves with the problems of X-ray examination of the female breast when proper management of the patient in most cases will lead to a biopsy anyway?" This question may be answered by repeating the dictum that there are no shortcuts in medicine. Any diagnostic information which may be obtained by additional study without detriment to the patient should be sought without stint or reservation. There is no thought of omitting an X-ray study of the chest in an individual with hemoptysis and a positive sputum! Similarly, there should be no hesitation to obtain whatever additional information may be made available by roentgen breast examination despite the clarity of the clinical picture. Completely

unsuspected disease may be uncovered in the breast under observation or, as has occurred in many instances in our experience, in the contralateral breast. One of the great values of the X-ray study has been the opportunity it has afforded in detecting disease processes before they become clinically manifest.

There is little doubt in our mind that the practice of breast roentgenography will lead to an increased number of positive breast biopsies for malignancy.

## Results

A review of the diagnostic accuracy achieved in 1000 consecutive breast examinations between November 1955 and March 1957 is presented in Table I. In this group, 372 cases had diagnostic resections.

Among the 144 women in whom the X-ray diagnosis was divided between adenosis, cysts, fibroadenomas, papillomas and intraductal hyperplasia, the diagnosis was verified by the pathologist in 141 cases. The malignant process was missed in three. Thus the X-ray diagnostic accuracy in this group was 97.9%.

In another group of 65 individuals, the X-ray findings were equivocal because the diagnosis of a benign condition was not deemed sufficiently accurate to contra-indicate biopsy. These individuals were therefore operated on and 5 cases with malignancy were discovered.

In another group of 82 women in whom a definite X-ray diagnosis of cancer was made, pathological verification was obtained in 81, an accuracy of 98.8%. It might be pointed out that these results were obtained in consecutive unselected examinations. In contrast to this group in which the X-ray diagnosis of malignancy was negative, there is still another group in which the suspicion of malignancy was raised without pathognomonic signs. The operative findings in this group showed that the X-ray diagnosis was no more than about 50% correct.

On the whole, the trained roentgenologist is able to make a diagnosis of breast disease in about 80% of all examinations; in the other 20%, a diagnostic resection must still be resorted to on the same clinical basis as now generally practiced. In the 80% group, accuracy of diagnosis is above 95%.

## Summary

With care in technique and familiarity of the roentgen criteria for the diagnosis of breast disease, the roentgenologist may make a definite diagnosis in approximately 80%. In our experience, this has caused a marked increase in number of positive biopsies. But more important has been the rising percentage of malignant processes without metastases which have been surgically removed due to the increased use of roentgenography in breast diseases.

**TABLE I**

1000 Consecutive Breast Examinations from 7/8/1955 to 4/11/1957

| ROENTGEN INTERPRETATION | No. of Cases | No. of Cases Operated Upon | OPERATIVE FINDINGS | | % Accuracy |
|---|---|---|---|---|---|
| | | | Normal or Benign | Malignant | |
| NORMAL | 99 | 10 | 10 | 0 | 100% |
| BENIGN | 585 | 144 | 141 | 3 | 97.9% |
| BENIGN LESIONS; but various mitigating circumstances indicate the need for biopsy* | 133 | 65 | 60 | 5 | 92.3% |
| MALIGNANCY SUSPECTED | 93 | 71 | 36** | 35 | 49.3% |
| DEFINITE MALIGNANCY | 90 | 82 | 1 | 81 | 98.8% |
| TOTALS | 1000 | 372 | 248 | 124 | |

*i.e. Very dense breast
Lesion in axillary tail of breast
Incompletely visualized lesion
Technically poor examination

**Includes severe intraductal hyperplasia